Patent Claims

1. Method for operating a piezoelectric motor having a stator in the form of a hollow-cylindrical oscillator, the at least one front side of which has frictional contact with a rotor and which comprises standing wave generators,
characterized in that
the hollow cylinder is set into a coupled tangential-axial oscillation mode so that the tangential and axial oscillatory speed components of the standing wave thus formed in the oscillator or, respectively, the points of the cylinder have the same phase or a phase difference of 180°, that the oscillatory speed maximums of the tangential component are formed on the front sides of the hollow cylinder and those of the axial component underneath thereof, wherein, towards the center of the cylinder height, parallel to the front sides of the cylinder, a nodal line is formed on which the axial oscillatory speed component adopts the value zero and the tangential component adopts a minimum, and wherein further axially extending nodal lines are formed in the hollow-cylindrical body in dependence on the mode order on which the axial or tangential oscillatory speed components adopt zero values.

2. Method according to claim 1,
characterized in that
the standing wave generators are excited with a frequency which corresponds to the oscillator resonance frequency and at which a standing wave of the coupled tangential-axial oscillation mode is formed.

3. Piezoelectric motor having a stator in the form of a hollow-cylindrical oscillator, the at least one front side of which has frictional contact with a rotor and which comprises standing wave generators,
characterized in that
the generators generate coupled tangential-axial oscillations in the hollow-cylindrical oscillator, wherein both components have the same phase

position or a phase difference of 180°, the tangential oscillatory speed maximums are located on the front sides and the axial oscillatory speed maximums underneath the same and wherein the same decrease towards half the height of the hollow cylinder so that the kinetic drive energy for the rotor is concentrated in the proximity of the front sides of the hollow cylinder, and wherein further a mechanical attachment for the motor is arranged or provided in the central portion on the zero line of the values of the components.

4. Piezoelectric motor according to claim 3,
characterized in that
the hollow-cylindrical oscillator is a monolithic piezoelectric body on the one surface area of which one or more electrodes are provided and on the other surface area of which a common reference electrode is provided, both forming generators of standing waves together with the piezoelectric ceramic disposed therebetween.

5. Piezoelectric motor according to claim 3,
characterized in that
the hollow-cylindrical oscillator is a monolithic non-piezoelectric body, wherein the generators are constructed as piezoelectric elements rigidly connected to the hollow cylinder with corresponding electrodes.

6. Piezoelectric motor according to one of claims 3 to 5,
characterized in that
the oscillator comprises two standing wave generators spatially displaced by one fourth of the wavelength, the electrical excitation of which has a phase quadrature by which a traveling wave is generated in the oscillator and the rotor has a moving direction opposite to the traveling wave.

7. Piezoelectric motor according to one of claims 3 to 5,
characterized in that

the oscillator comprises three standing wave generators spatially displaced by one third of the wavelength, the electrical excitation of which has a phase displacement by 120° by which a traveling wave is generated in the oscillator and the rotor has a moving direction opposite to the traveling wave.

8. Piezoelectric motor according to claim 3,
characterized in that
the oscillator comprises at least one group of like generators of acoustic standing waves displaced against each other by half a wavelength and connected to an electrical exciting source, wherein the oscillator height is selected such that a longitudinal mode is excited simultaneously with the tangential-axial mode, wherein the superposition of both modes causes the points located on the front sides of the hollow cylinder to perform elliptical or straight movements.

9. Piezoelectric motor according to one of claims 3 to 8,
characterized in that
the hollow-cylindrical oscillator body has a conical shape on the front insides thereof so as to guide and mount the rotor in a self-centering manner, which has a counter-conically shaped section at its respective ends.

10. Piezoelectric motor according to one of claims 3 to 8,
characterized in that
the standing wave generators are excited with a frequency which corresponds to the oscillator resonance frequency and at which a standing wave of the coupled tangential-axial oscillation mode is formed.

11. Piezoelectric motor according to one of claims 3 to 8,
characterized in that

a mechanical attachment for the stator is arranged or provided in the central portion of the hollow cylinder on the nodal line extending parallel to the front sides.